

Serial Shift Registers

- Serial Registers store data bits one at a time (1-bit per clock cycle)
- For 4-bit Shift register it consists of 4-D type FF connected in cascade

1

Now to Store the value 1101

1

0

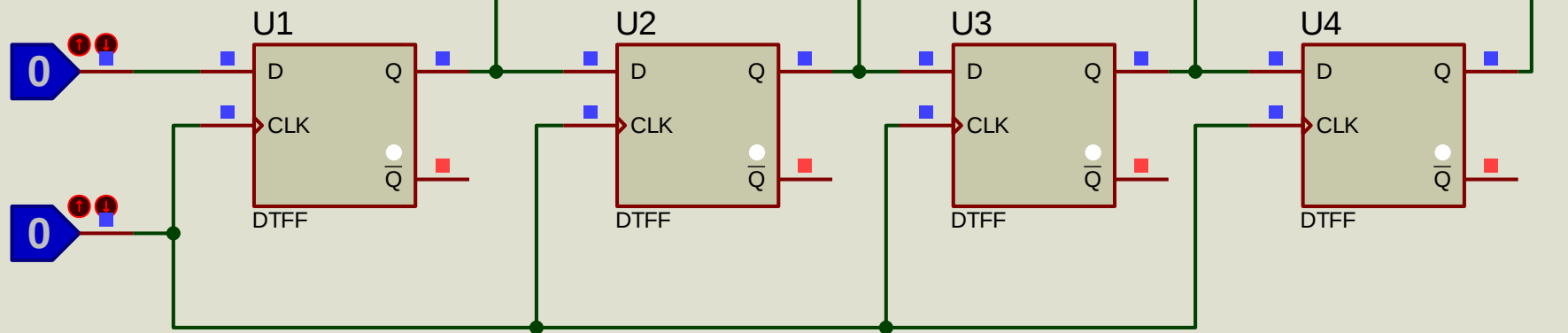
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0

0

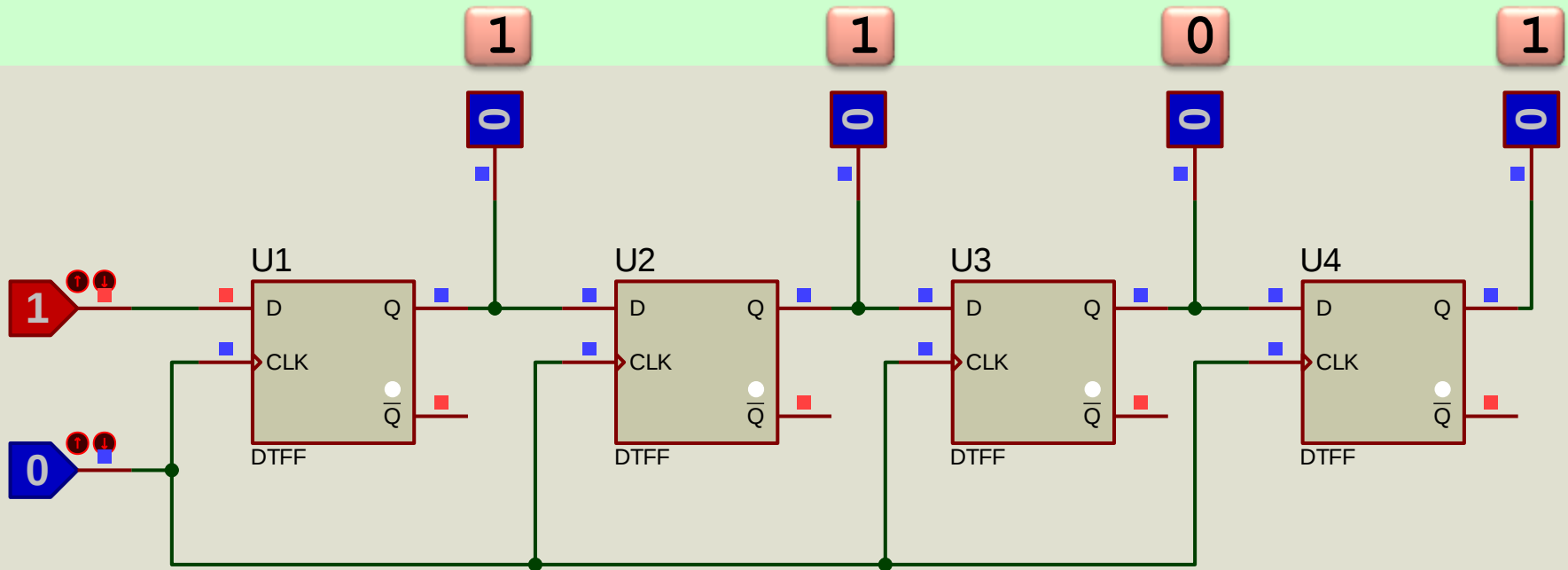
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0



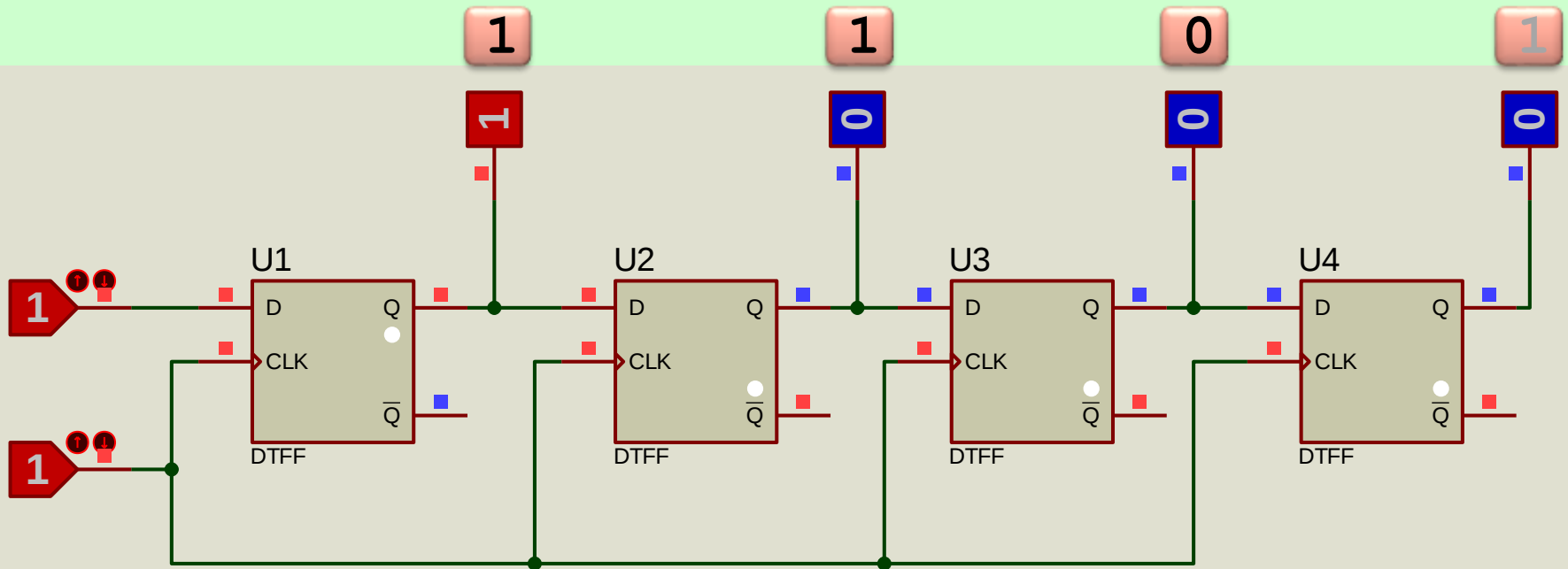
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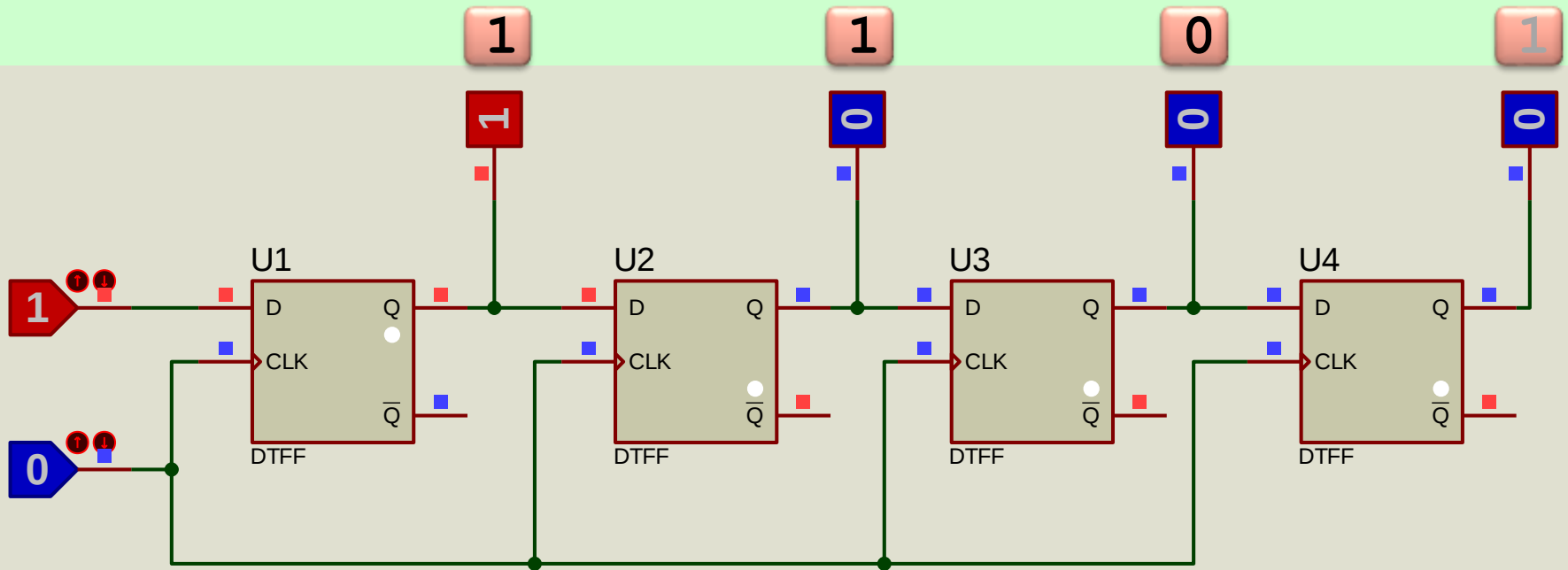
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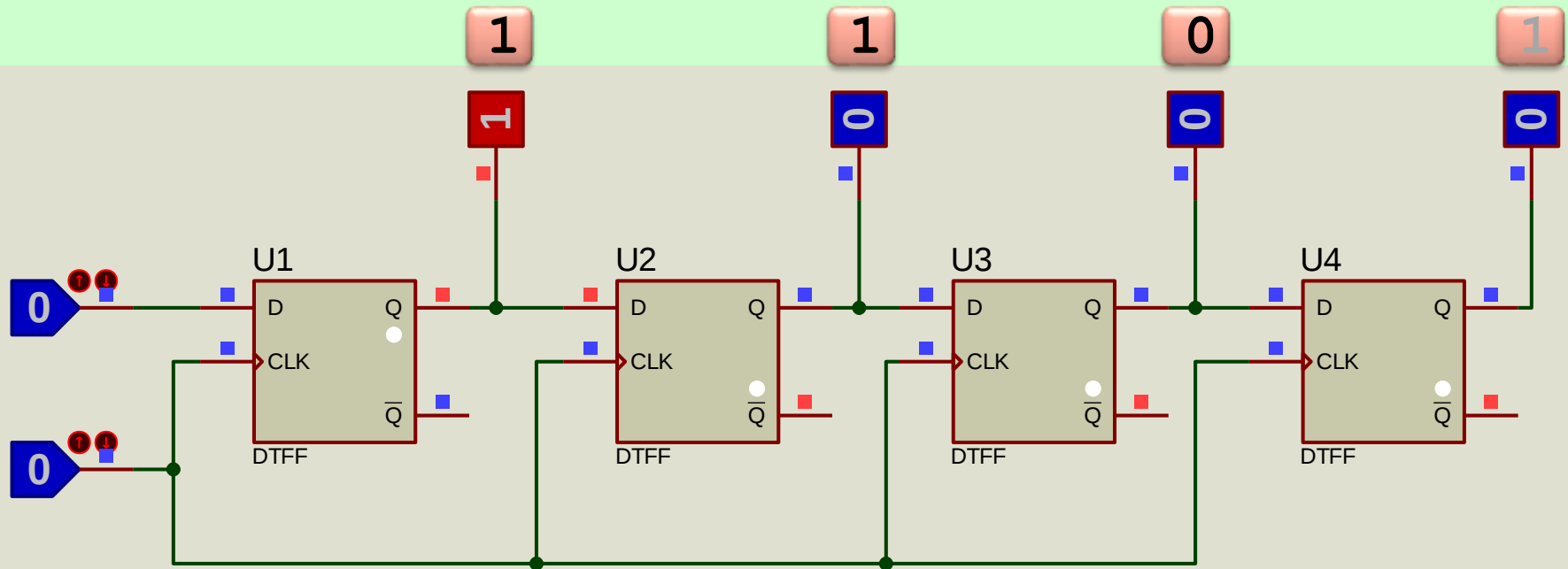
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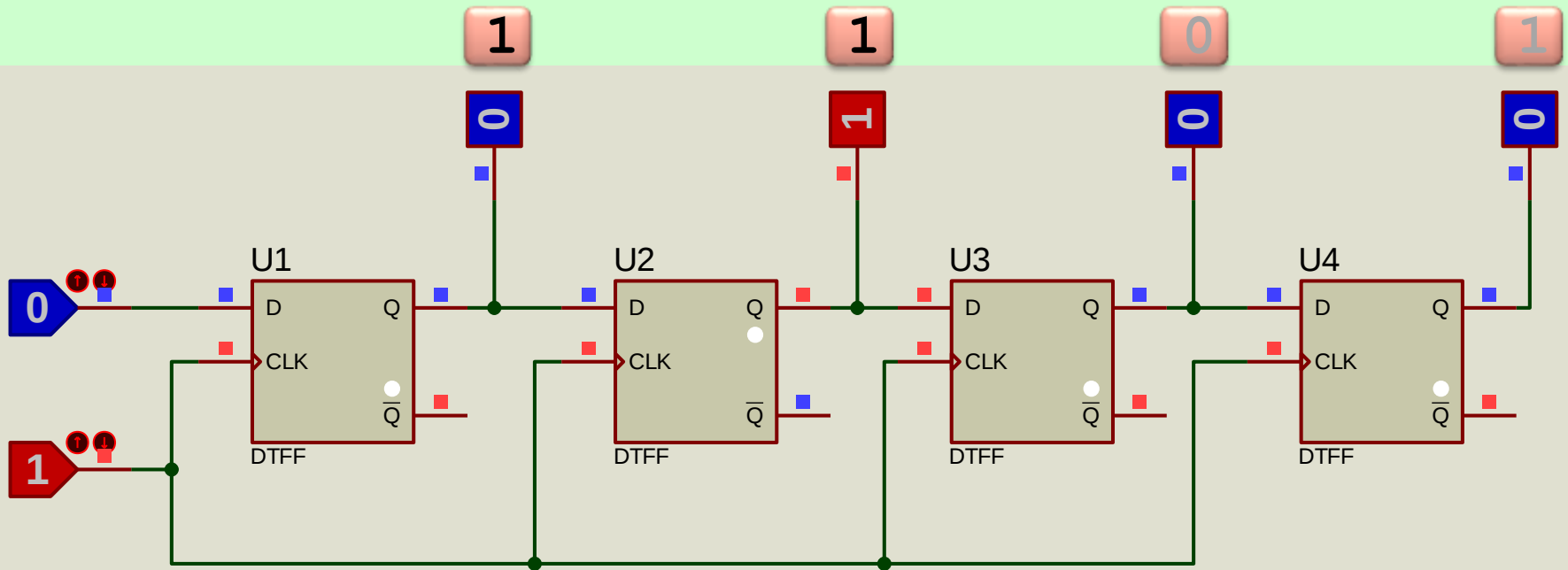
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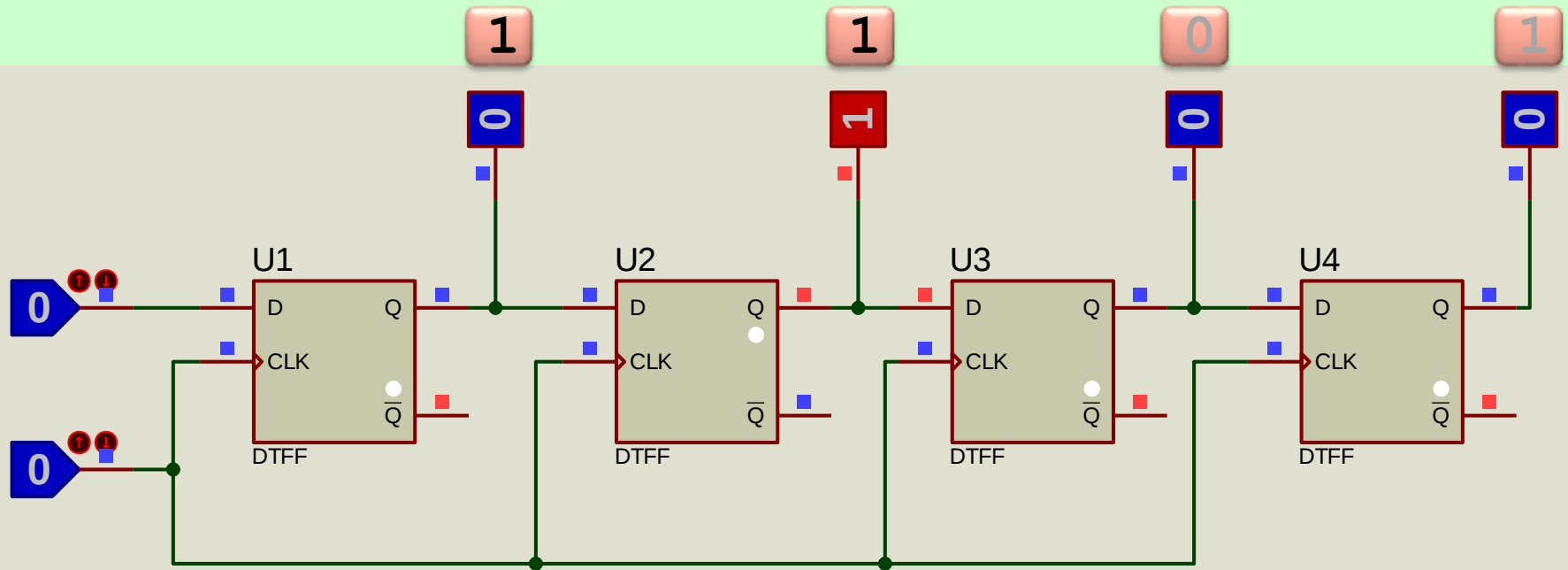
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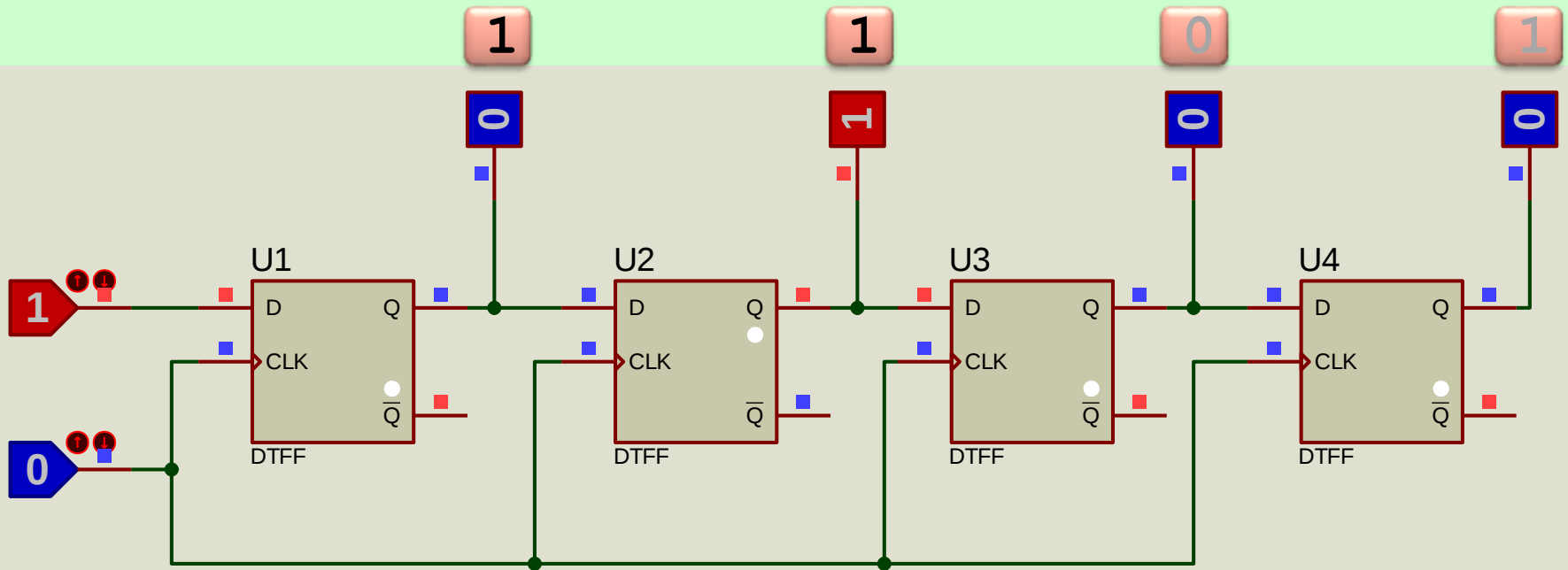
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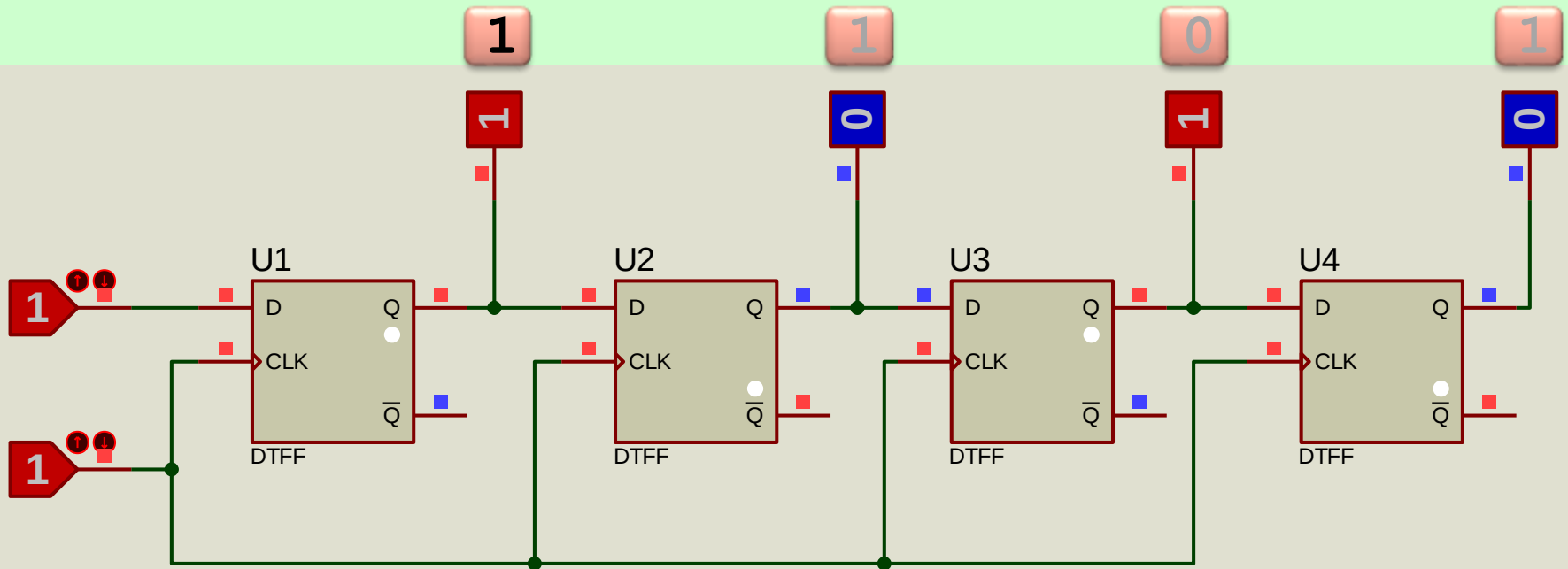
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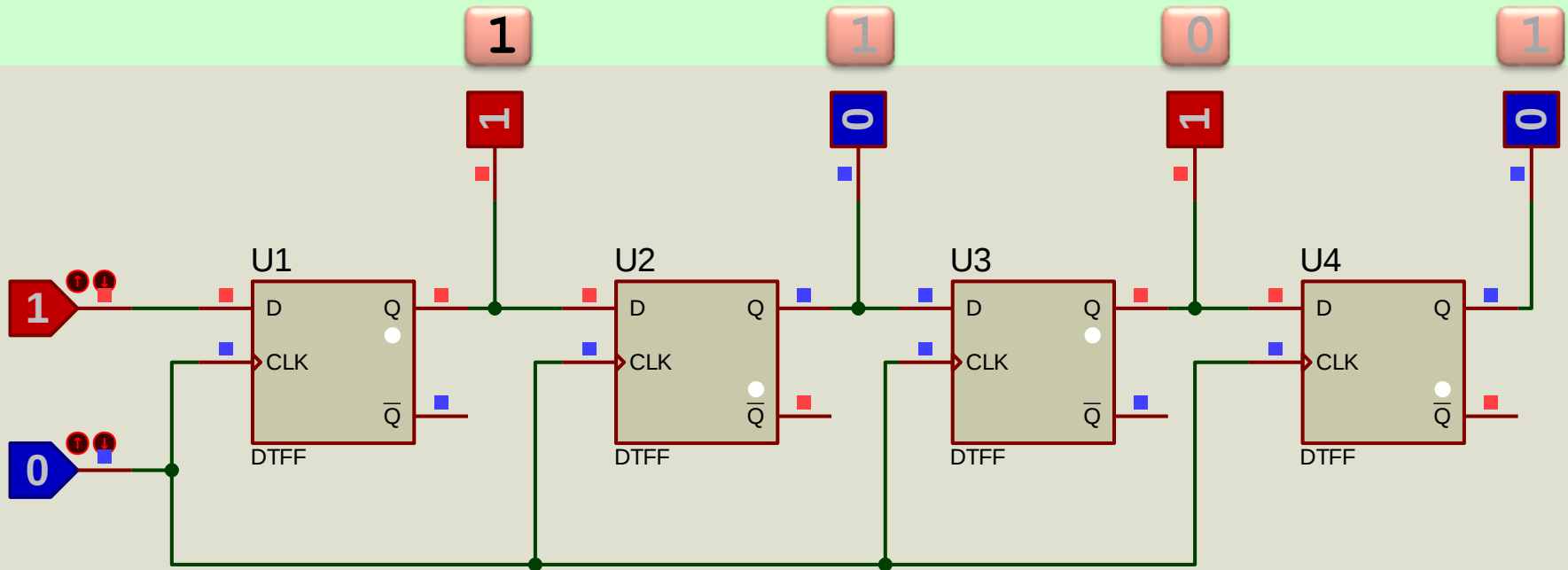
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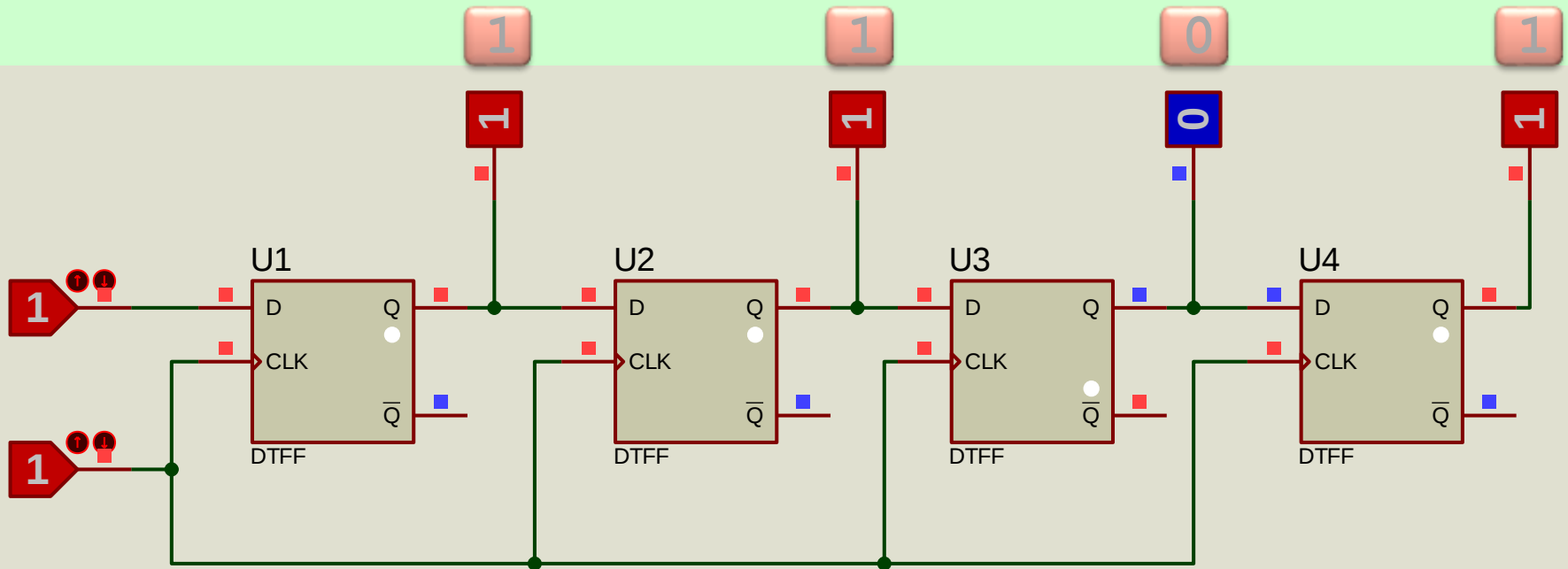
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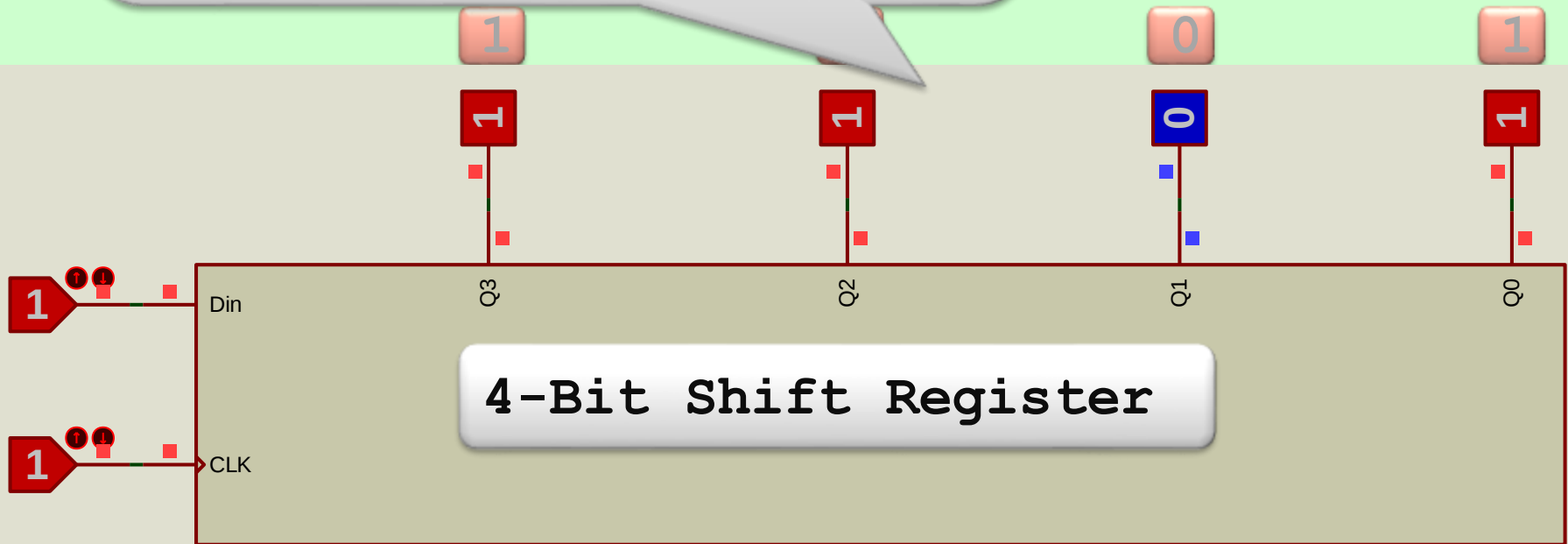
Serial Shift Registers

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Serial Shift Registers

- This is called serial in parallel out shift register used as Serial to Parallel converter
- of 4-D type FF



4-BIT REGISTER

Applications of Shift Registers

- Shift Registers can be used in various applications
- The most important applications are:
 - Serial to Parallel data converter
 - Parallel to Serial data converter
 - Counters (especially “step counters”)
- We have discussed the Serial to Parallel data converter, which converts serial data bits to parallel data
- It is also called Serial in Parallel out Shift Register

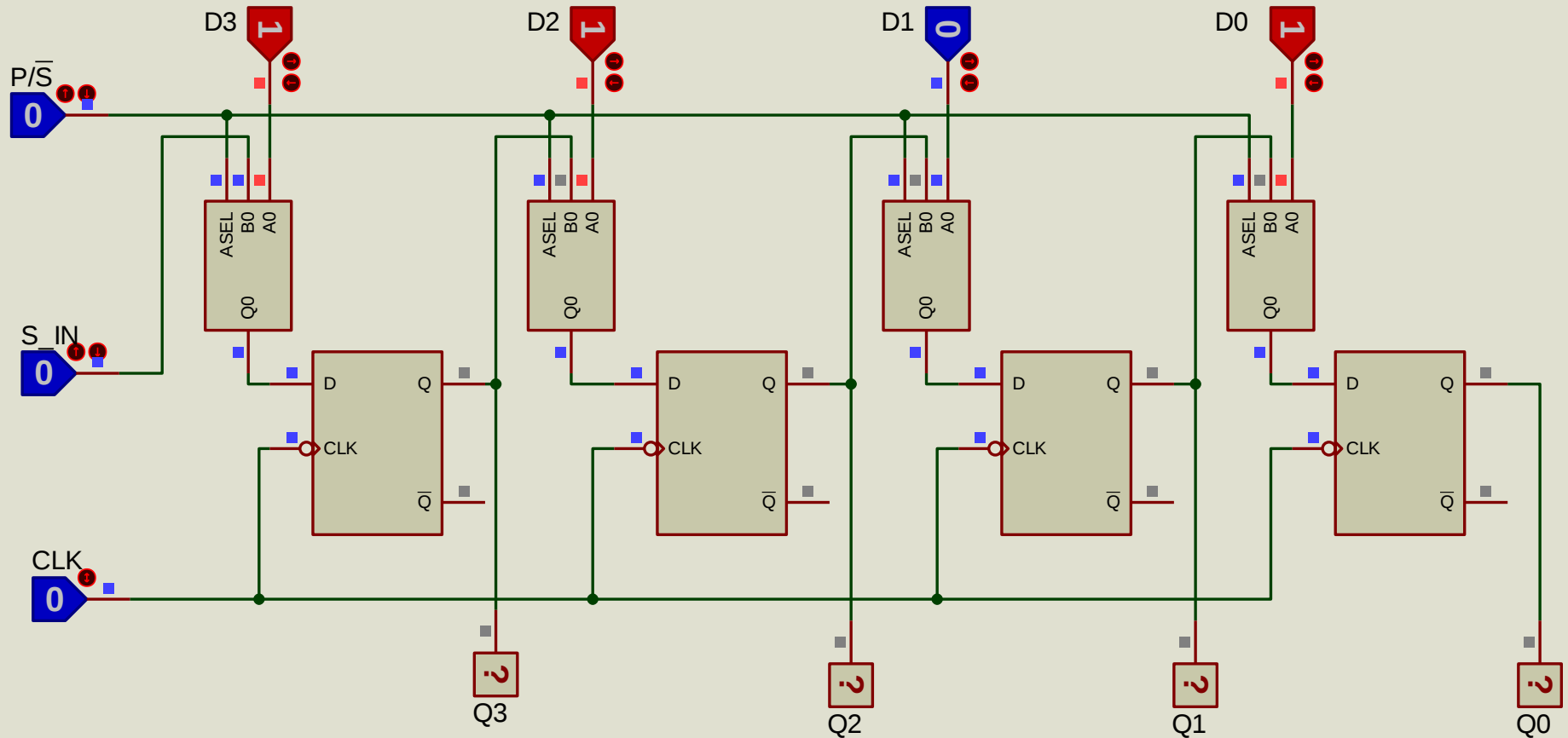
Applications of Shift Registers

Parallel in to Serial out Register

- It is also called Parallel in Serial out shift register
- To convert data from parallel to serial, the shift register must be loaded with parallel data, then shifting these data out
- So this register has parallel data load control signal
- It can be constructed from D-FFs and MUX
- The D- input for each FF is either connected to
 - Data line from parallel input or
 - Q output from previous FF
- MUX can do this selection

Applications of Shift Registers

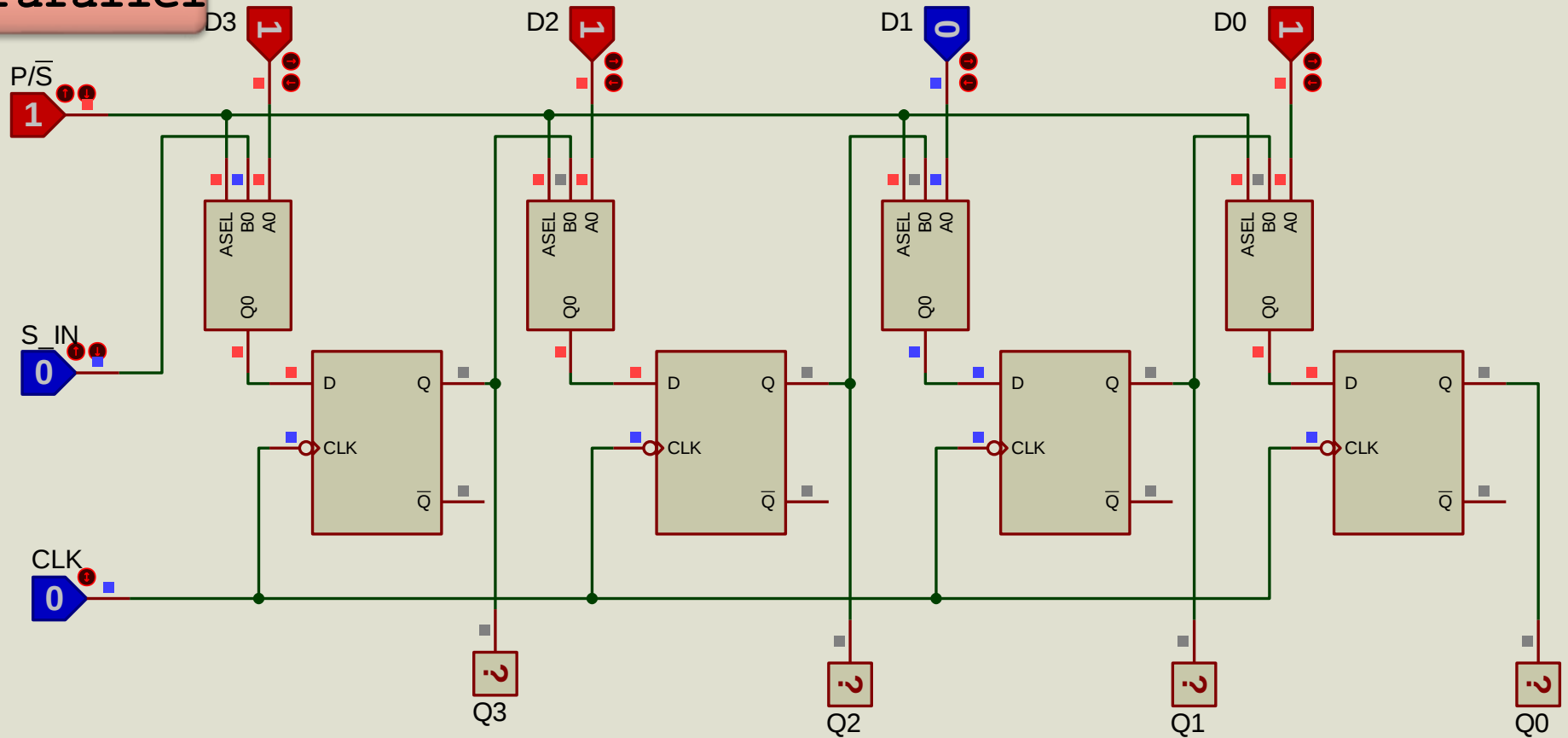
Parallel to Serial Register



Applications of Shift Registers

Parallel to Serial Register

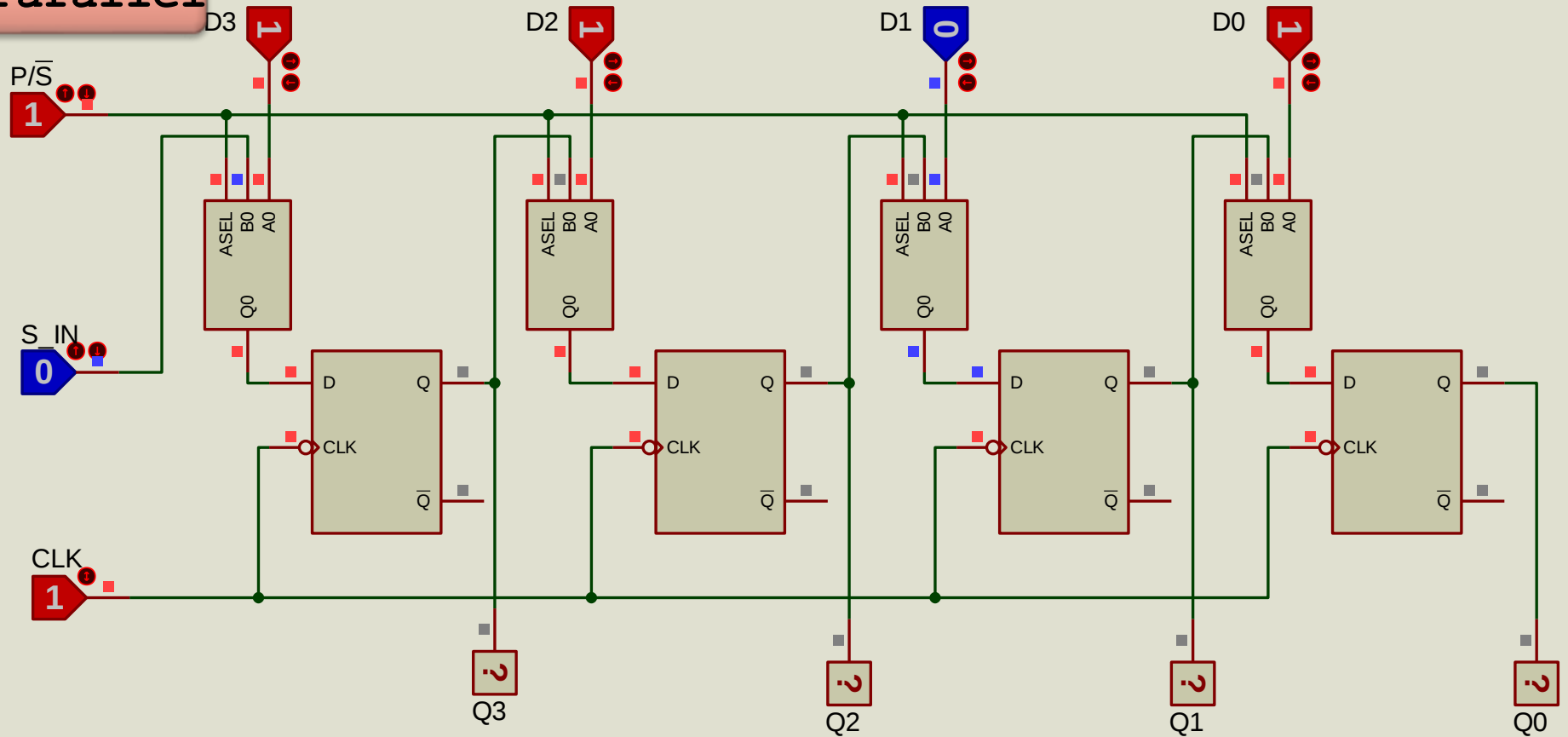
Parallel



Applications of Shift Registers

Parallel to Serial Register

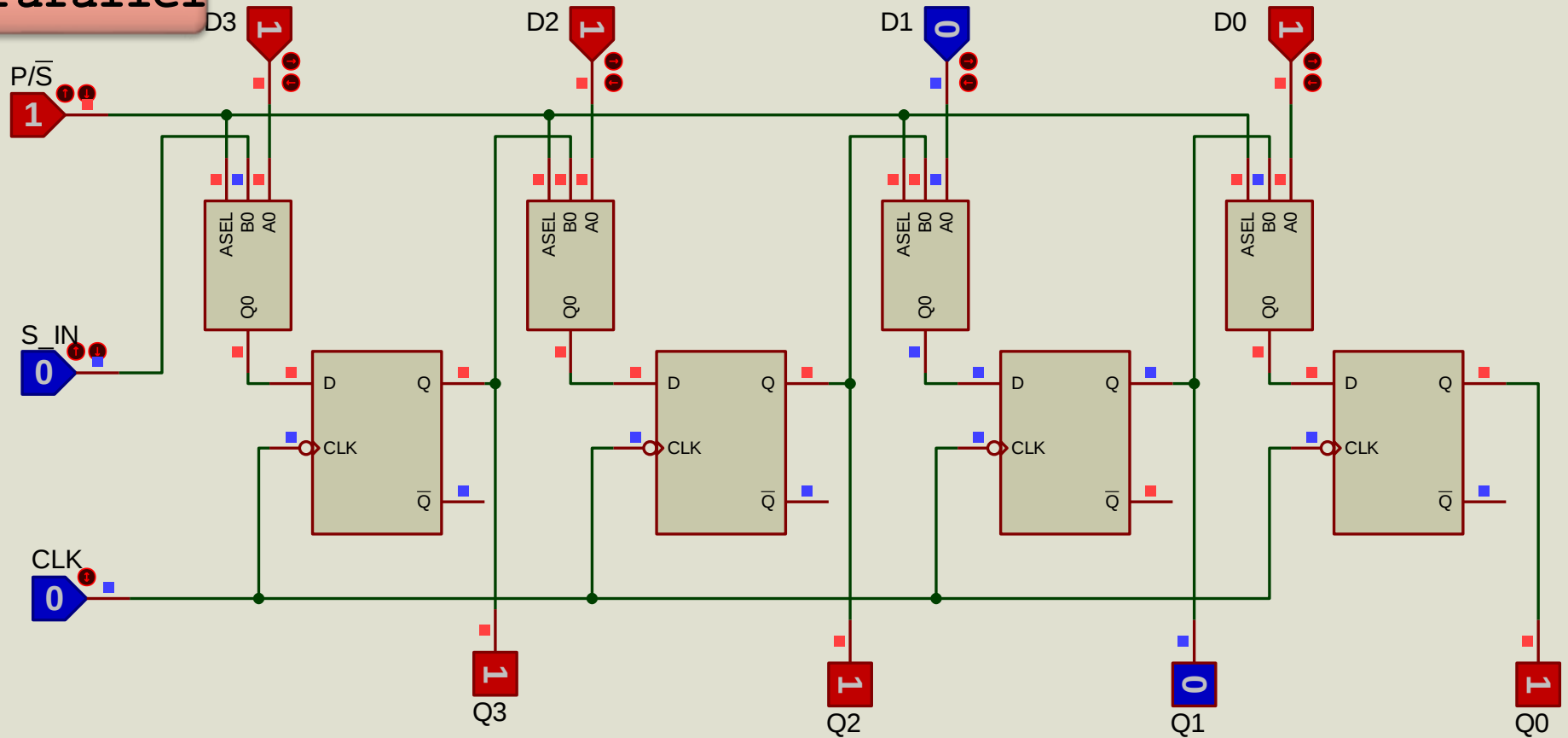
Parallel



Applications of Shift Registers

Parallel to Serial Register

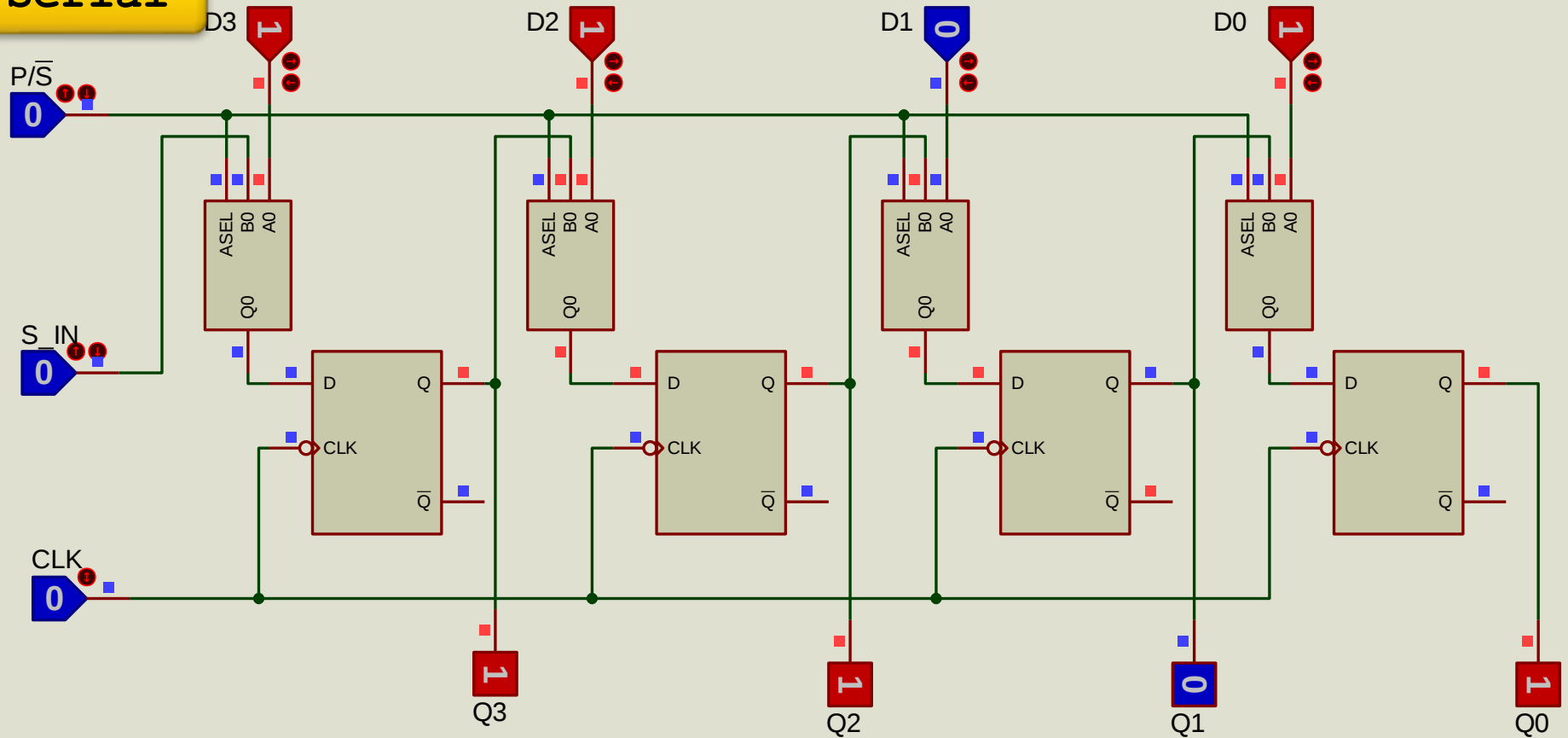
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Applications of Shift Registers

Parallel to Serial Register

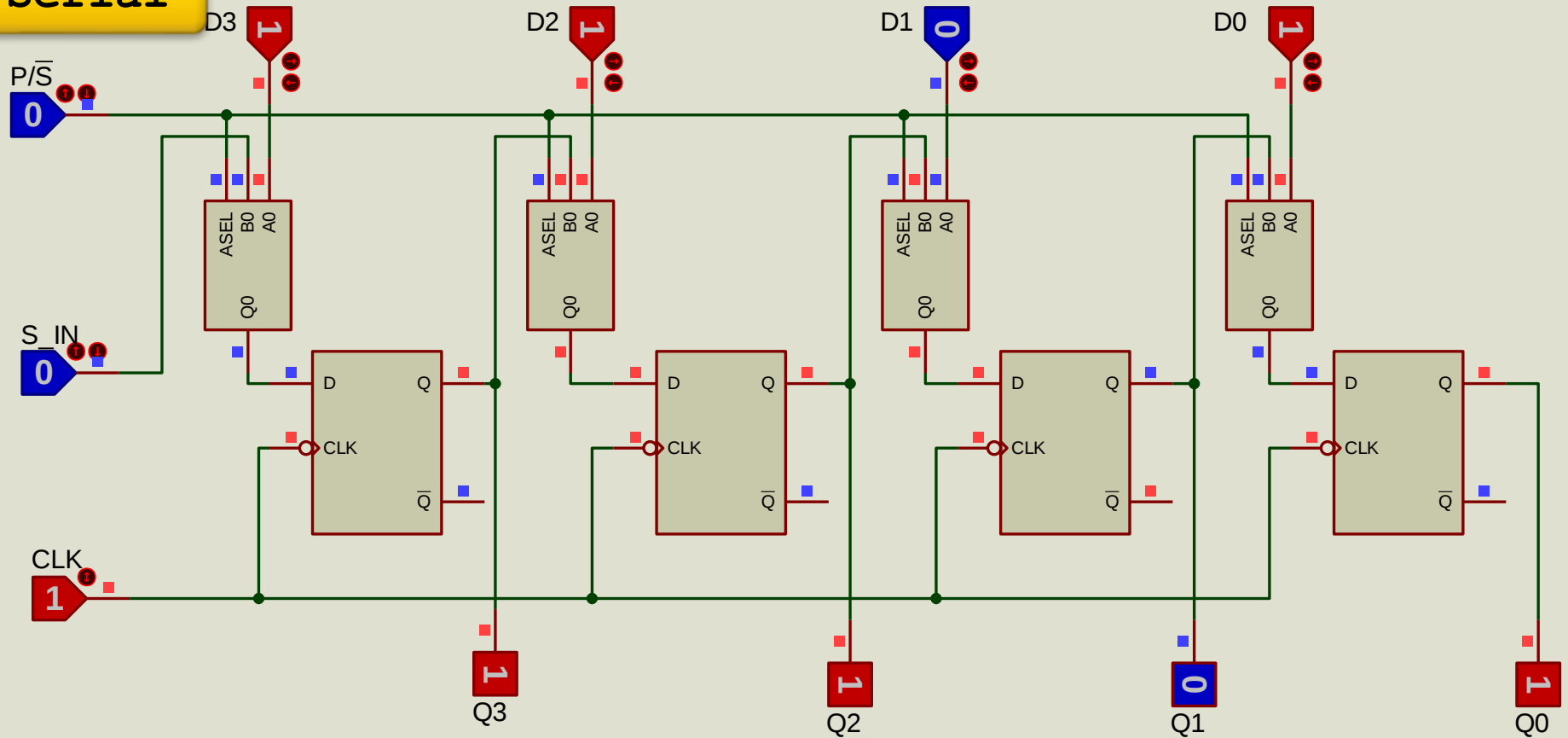
Serial



Applications of Shift Registers

Parallel to Serial Register

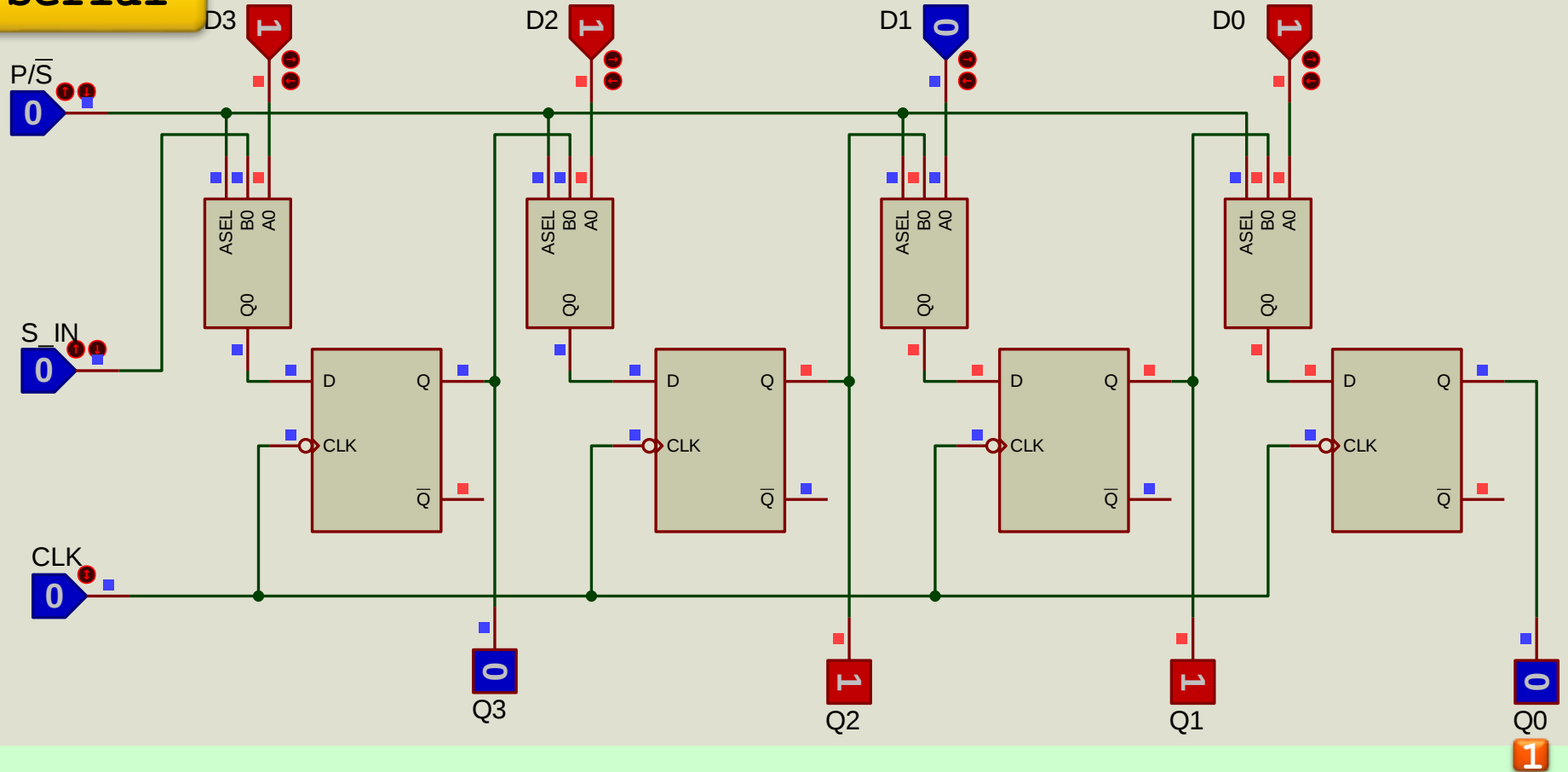
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Applications of Shift Registers

Parallel to Serial Register

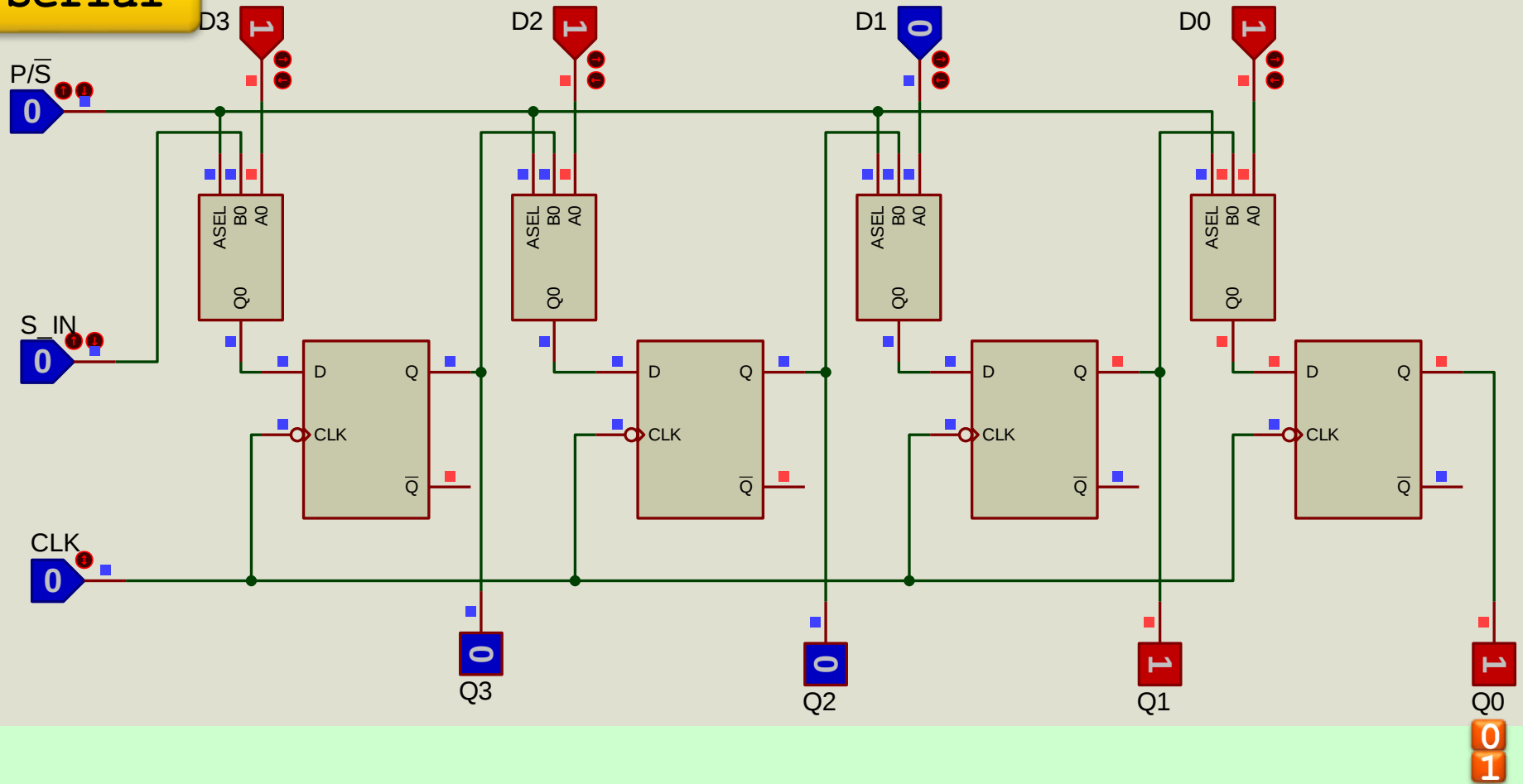
Serial



Applications of Shift Registers

Parallel to Serial Register

Serial

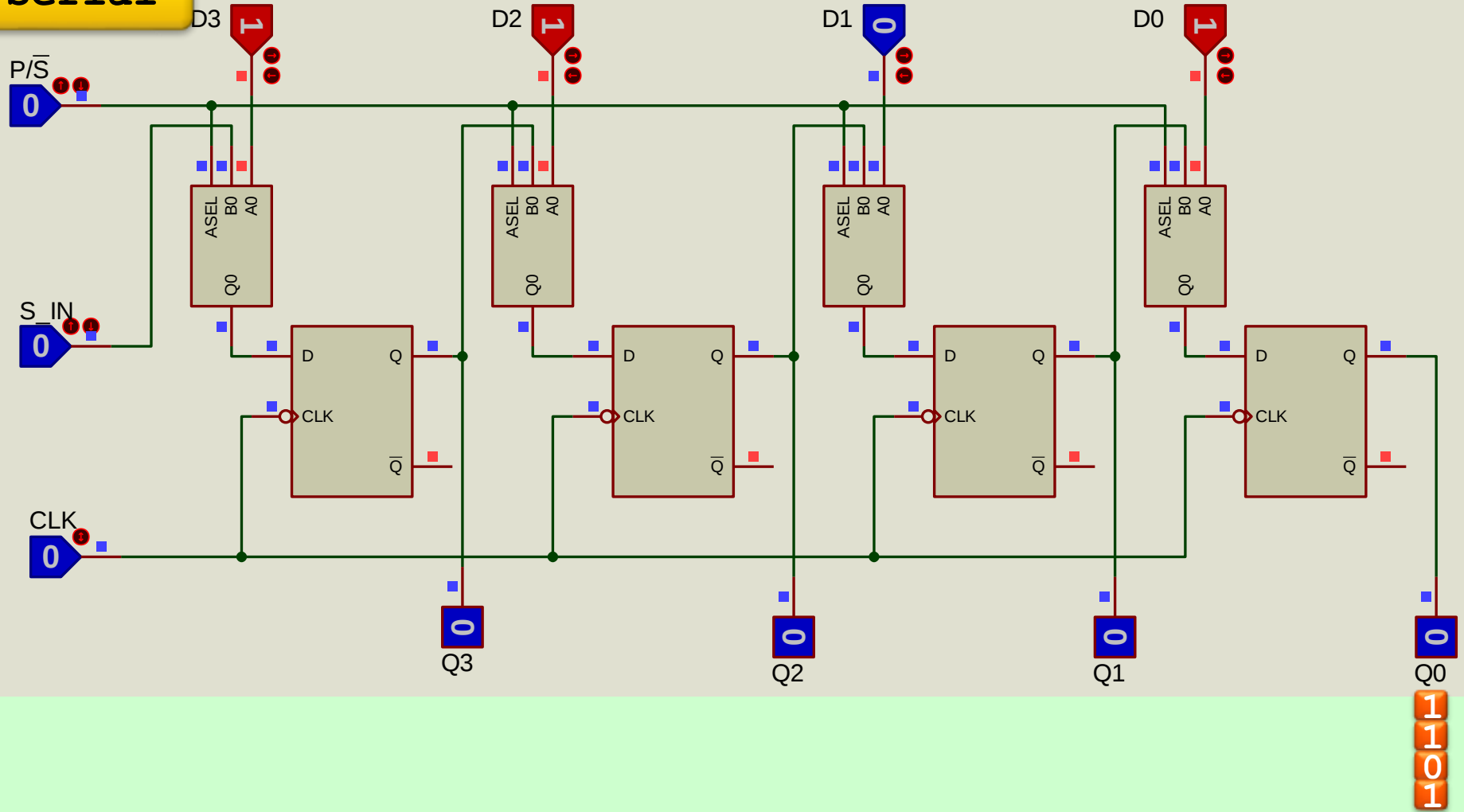


Parallel to Serial Register

Applications of Shift Registers

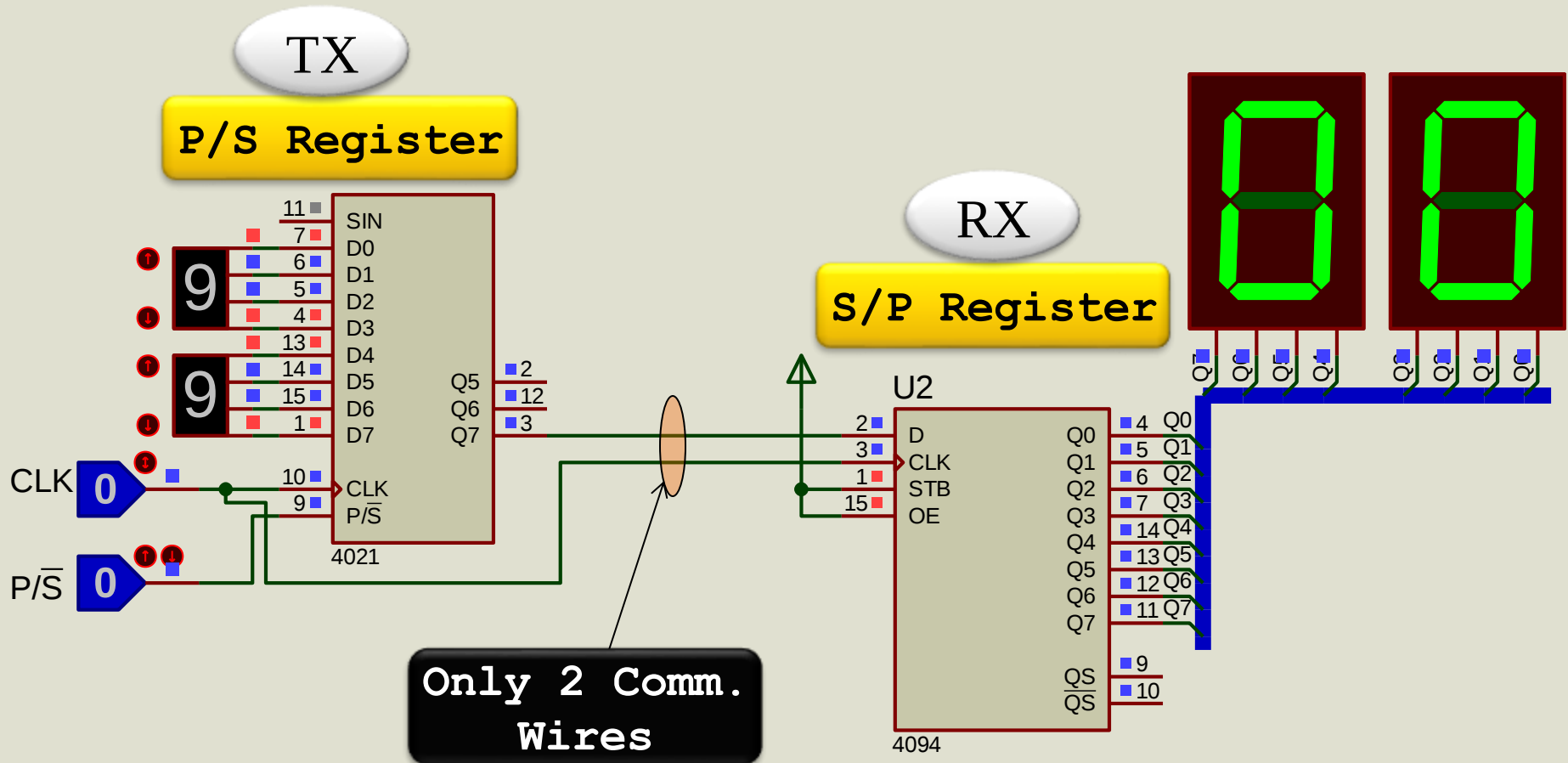
Parallel to Serial Register

Serial



Applications of Shift Registers

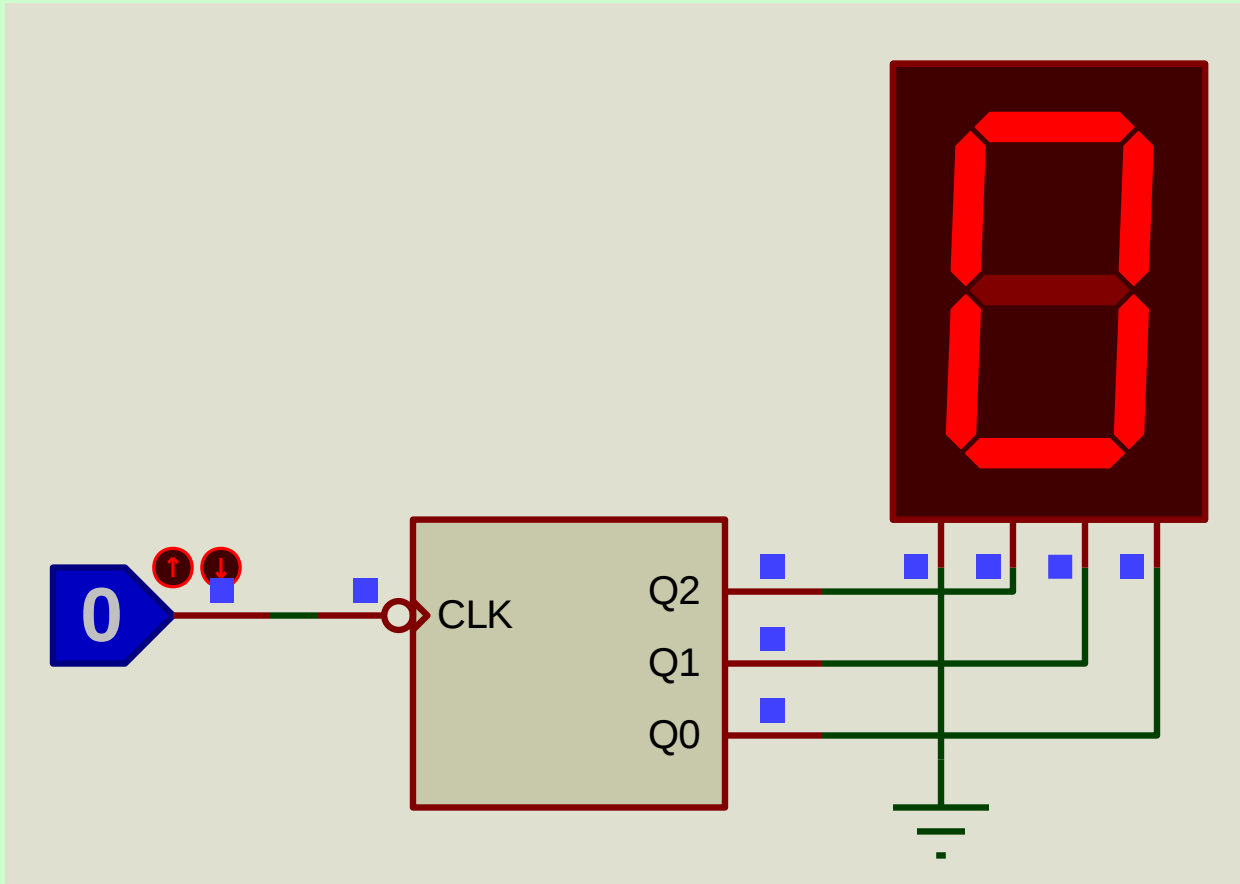
Synchronous Serial Communication



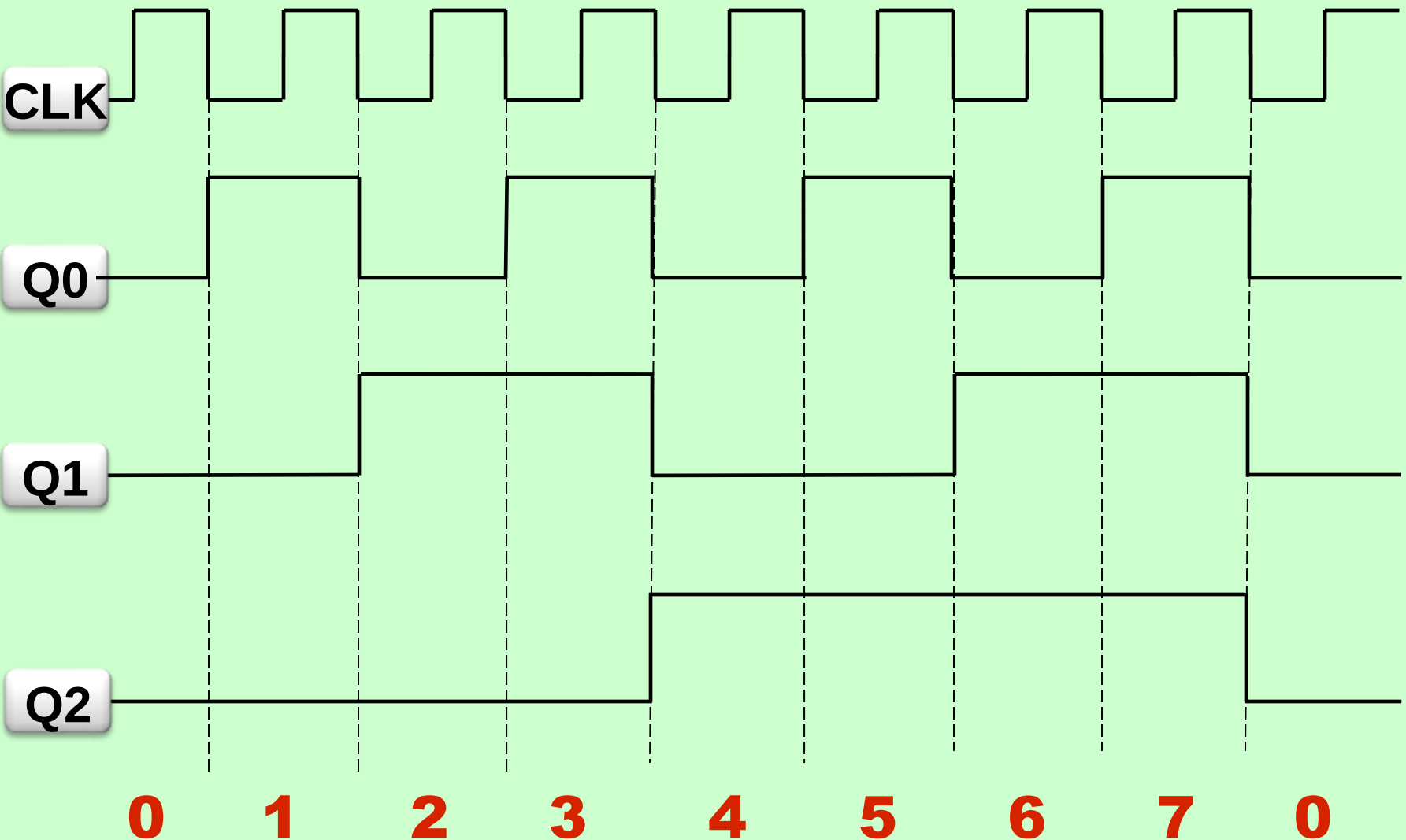
Binary Counter

- Counter is a sequential logic circuit that has only one input (Clock) and several outputs ($Q_0, Q_1, Q_2, \dots$)
- With each clock pulse the counter changes its output through different states
- It is called divide by N counter if the sequence of output repeats after N states
- Binary counter produces output states in an incremented or decremented sequence (0, 1, 2, 3, 0, 1, 2, 3, ...)

Binary Counter (divide by 8)

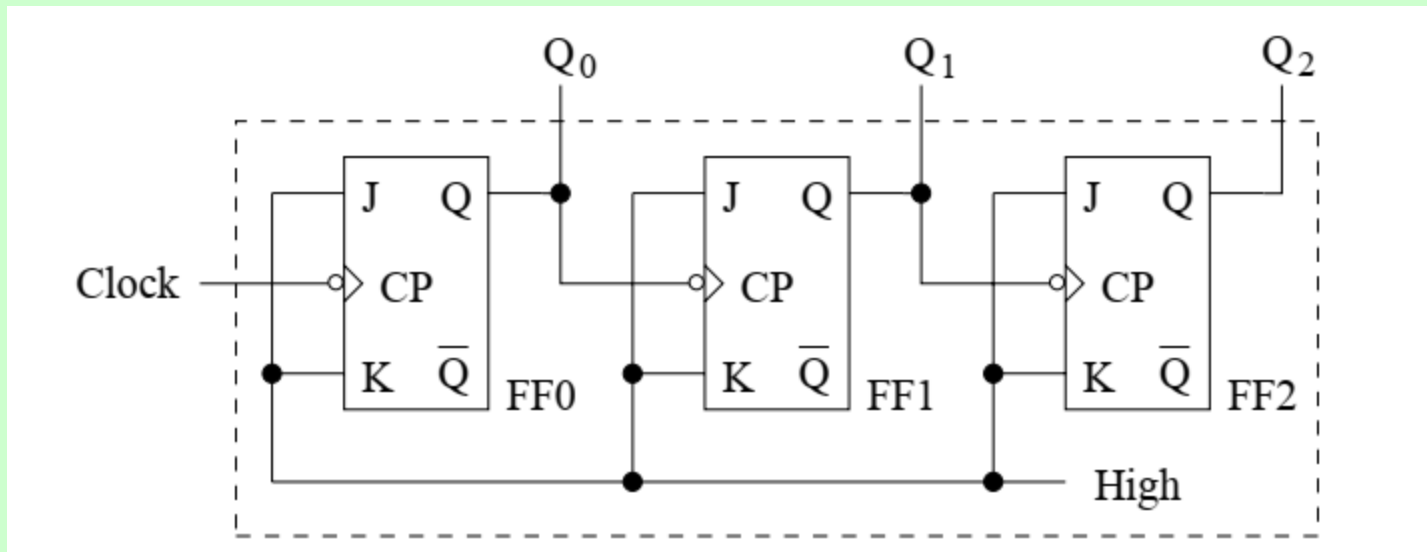


Binary Counter Timing Diagram



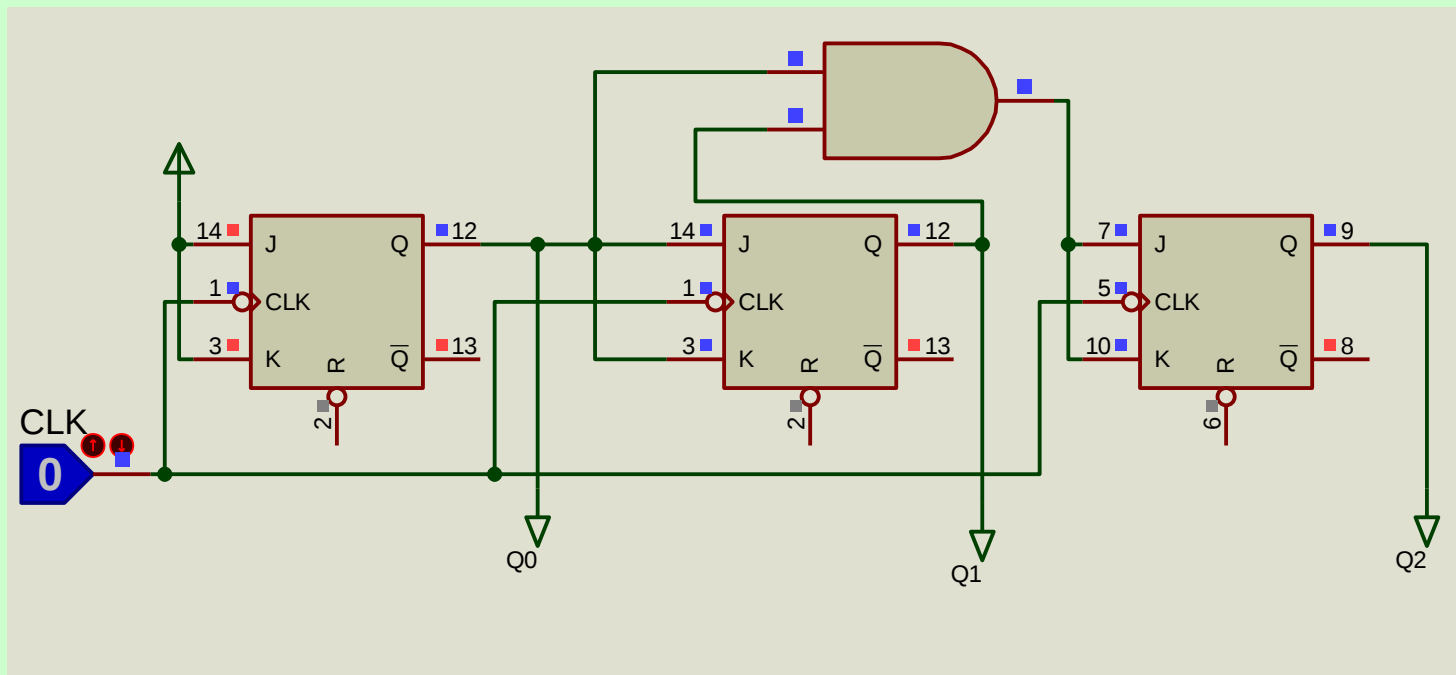
Asynchronous Binary Counter

- Q0 toggle with each –ve edge of clock
- Q1 toggles with each –ve edge of Q0
- Q2 toggles with each –ve edge of Q1
- So it is possible to construct the counter using J-K FF
- But this configuration is *Asynchronous*



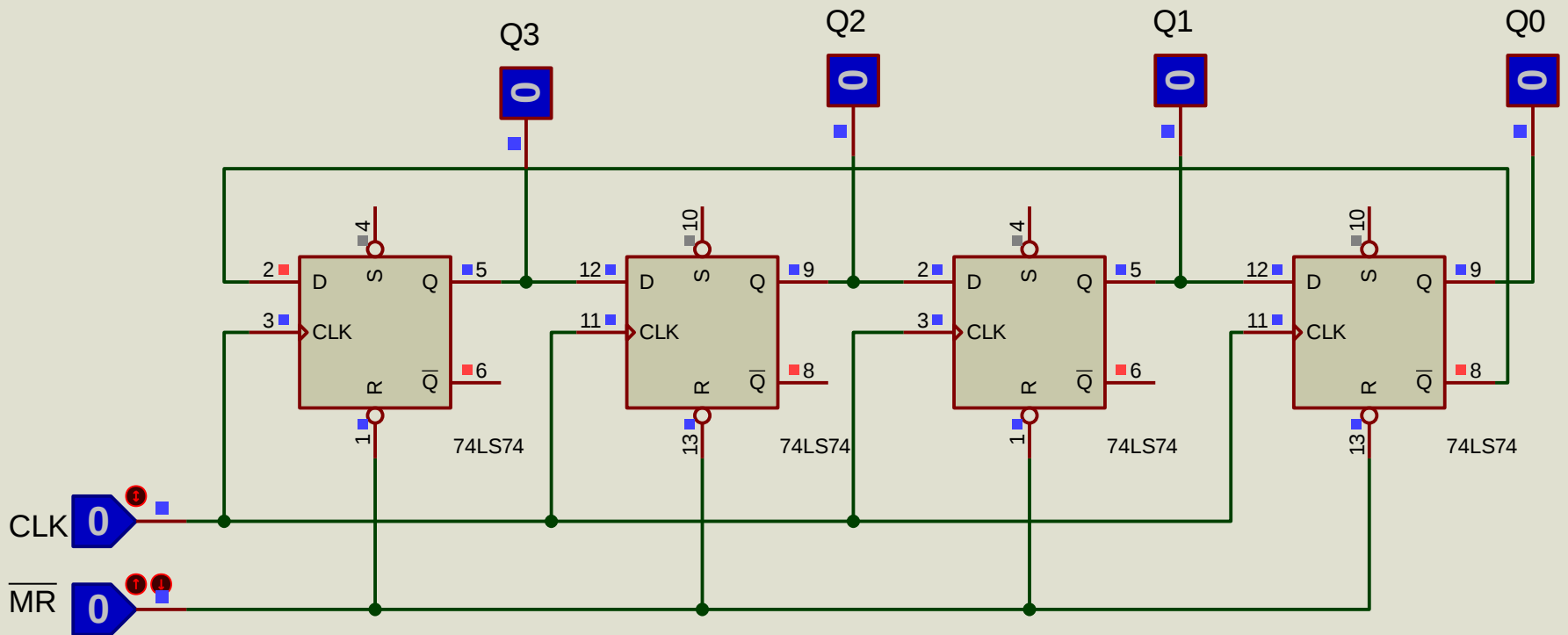
Synchronous Binary Counter

- To construct Synchronous counter, the clock must be connected to all CLK inputs of the FFs
- *We can show that*
 - *$Q1$ toggle with each -ve edge of clock when $Q0=1$*
 - *$Q2$ toggles with each -ve edge of clock when both $Q0$ & $Q1=1$*

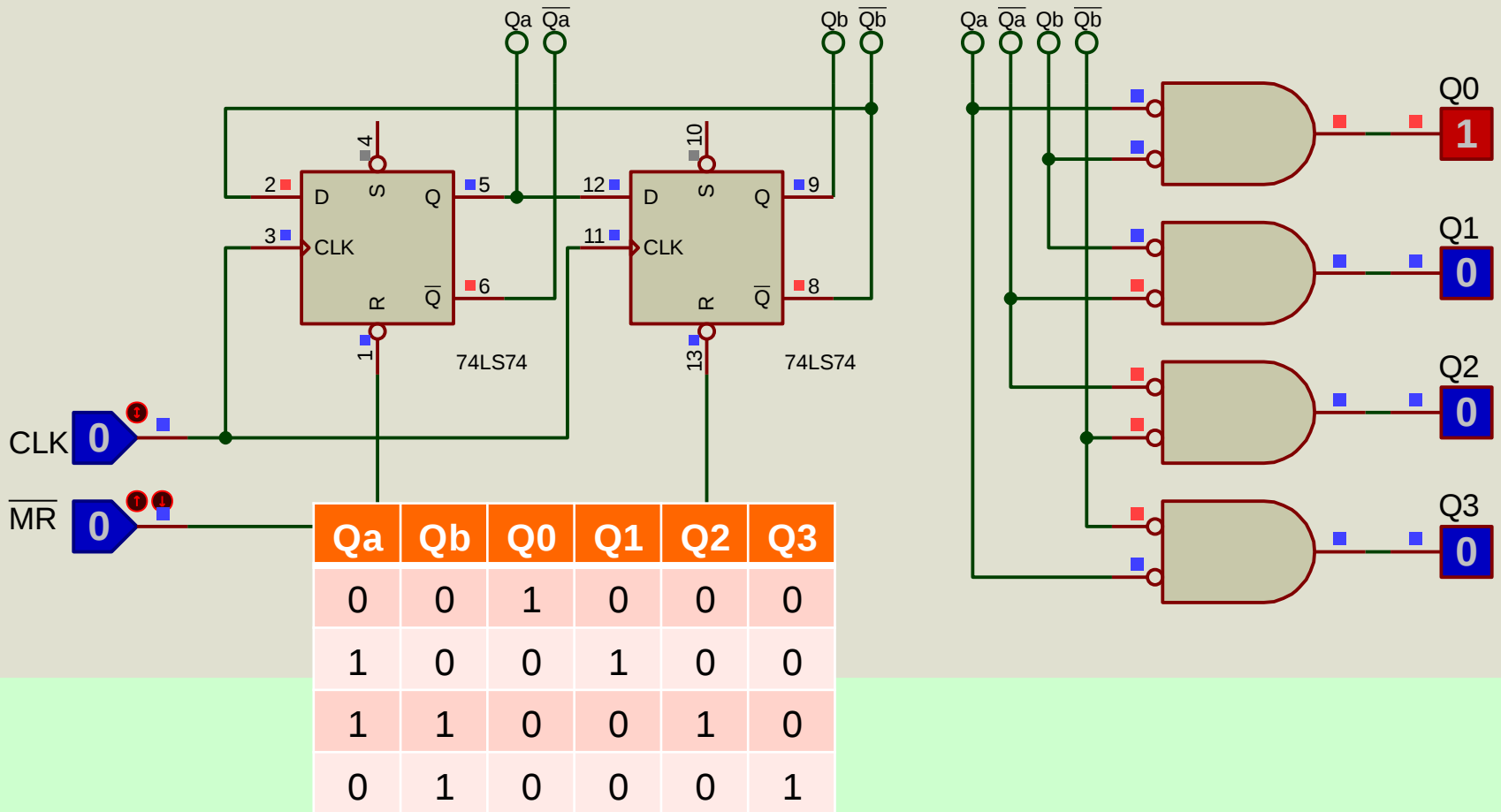


Counters using Shift Registers

Johnson Counter using Shift Register



Step Counter using Shift Register



Counters using Shift Registers

Practical Step Counter “4017”

- It is a decade ($\div 10$) step counter with Reset & Clock Enable
- It can be used as
- Divide by $N \leq 10$ counter
- Count to N and stop

